

Biophysical characterization

Identification of the key biophysical production constraints to crops and livestock at farm and landscape levels

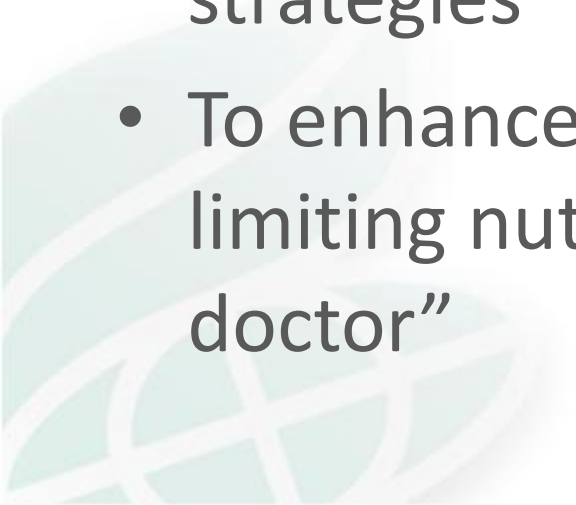
J. Kihara & L. Winowiecki



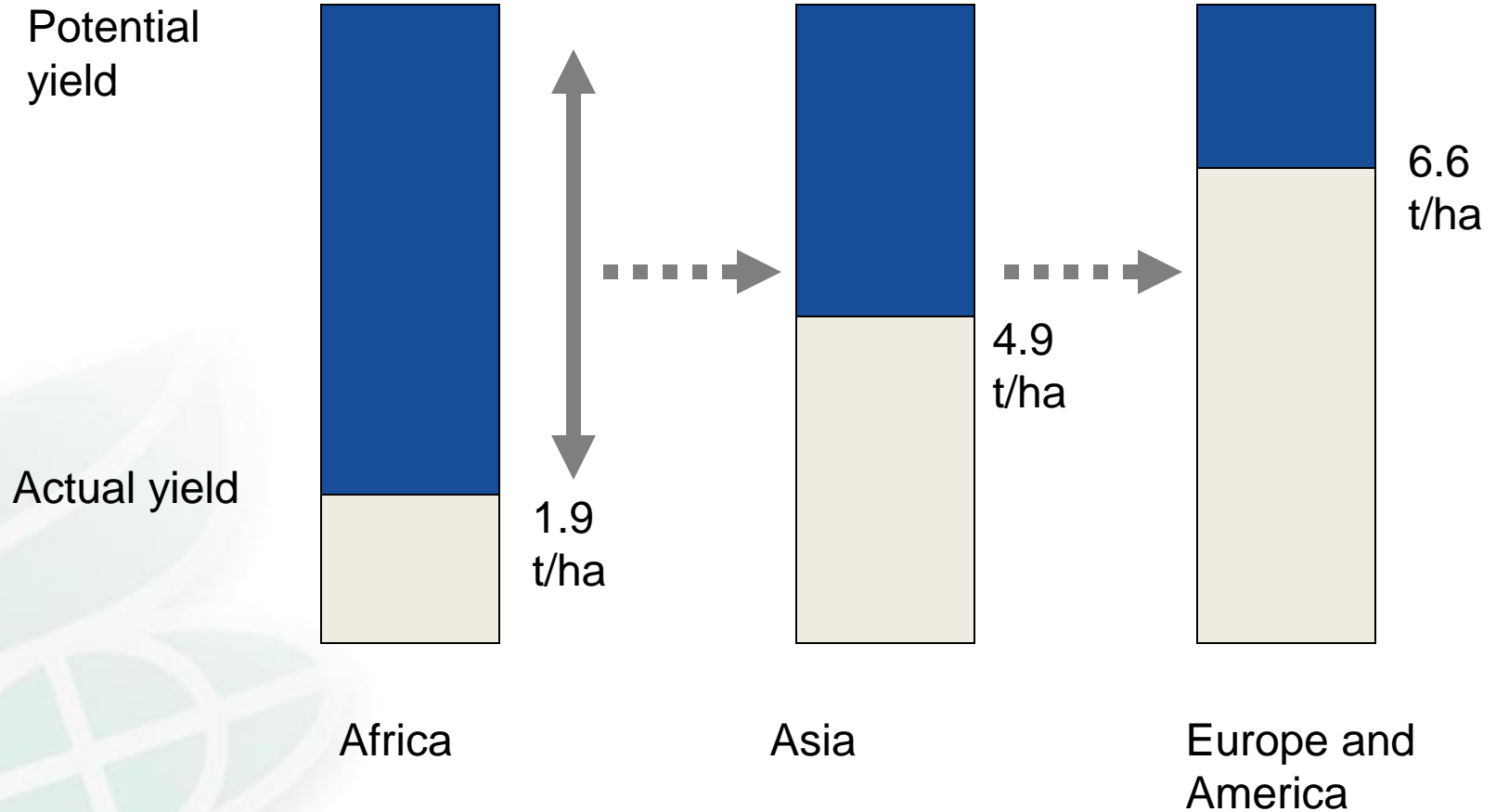
International Center for Tropical Agriculture
Since 1967 / *Science to cultivate change*

www.ciat.cgiar.org

Objectives

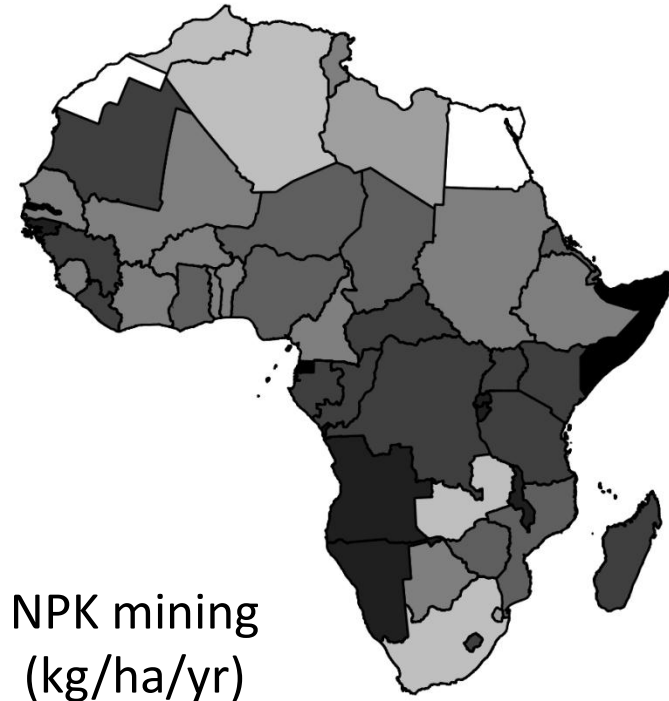
- To conduct an integrated assessment of soil and ecosystem health
 - To conduct agronomic survey to estimate actual yield obtained by farmers in their own practices and relation with management strategies
 - To enhance farmer knowledge to identify limiting nutrients through a translated “maize doctor”
- 

World maize production



Soil health matters

- Food insecurity largely a result of low agricultural production
- “our soils are tired”
- We are constantly mining the soil (>50 kg NPK/ha/yr for Tanzania)
- High variability in responses
- Limited, if any, use of fertilizers
- N very limiting in most cases, P also and evidence emerging for K
- Less focus on other nutrients
- Unbalanced nutrition
- Entry point to discuss other management practices- e.g., plant spacing

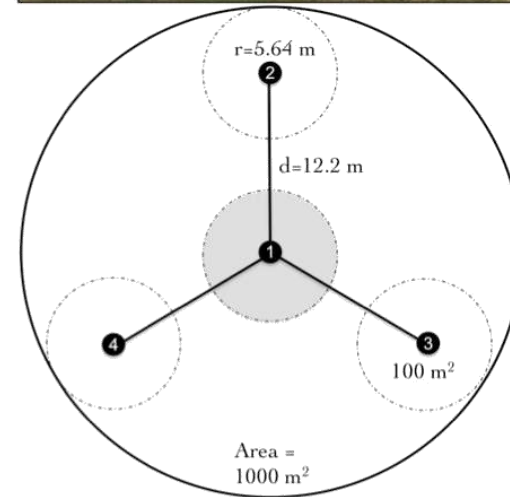
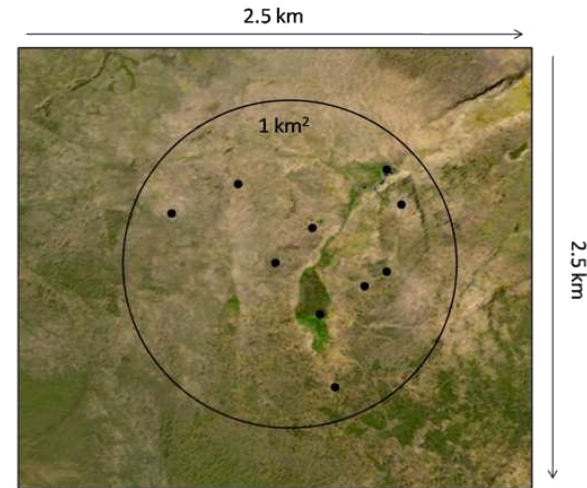


(Underlying data for years 2002-04, from Henao and Baanante 2006)

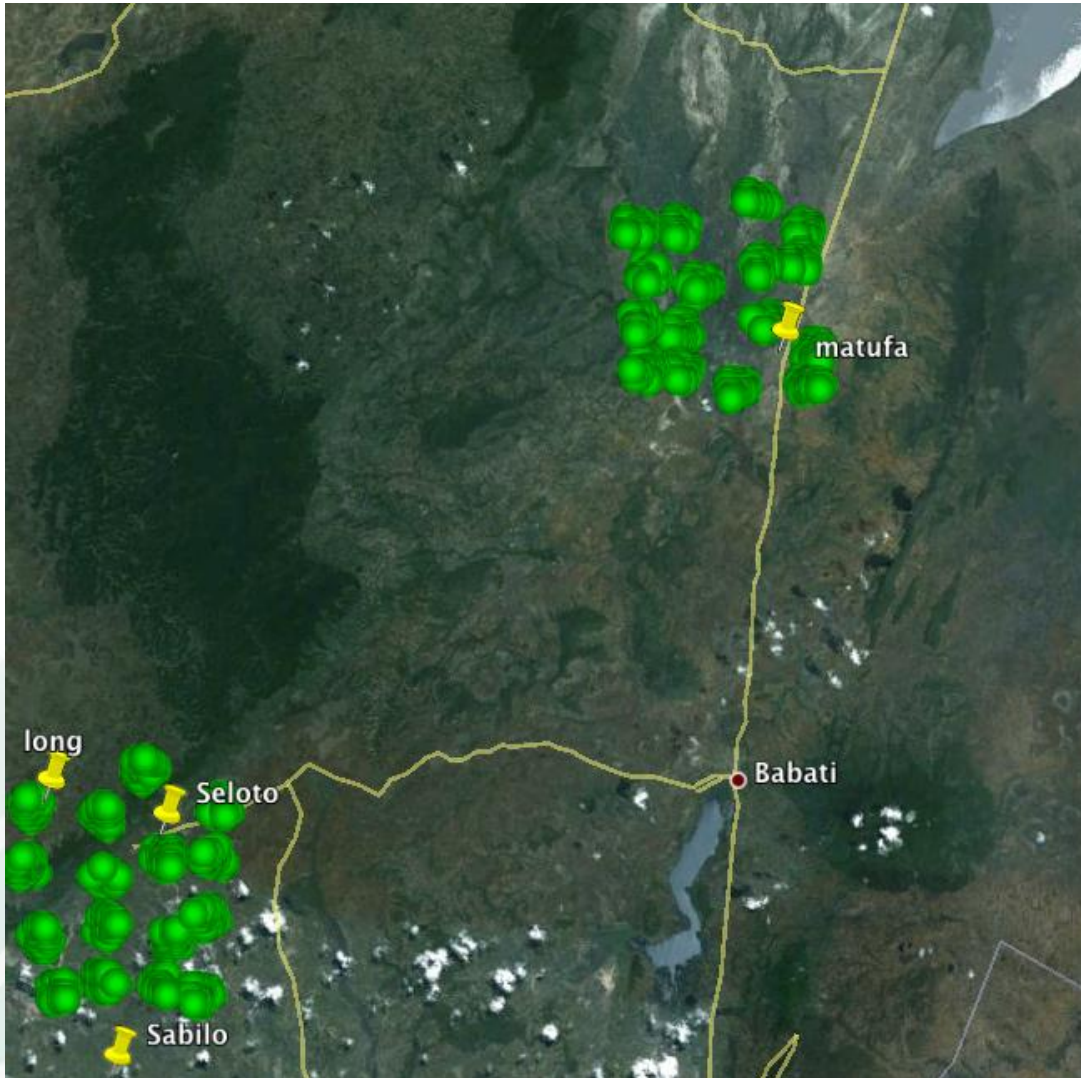
Call for Systematic Unbiased Methods

Land Degradation Surveillance Framework

Each LDSF site is 100 sq. km
and has 160 sampling plots
(each 1000 m²)



The key sites



- LDSF sites near Long and Matufa
- Co-located Two LDSF surveys with agronomic survey data

Sustainable Intensification



The LDSF survey will sample the intensive agricultural production, such as Cluster 7 in the Long LDSF site.

Sustainable Intensification



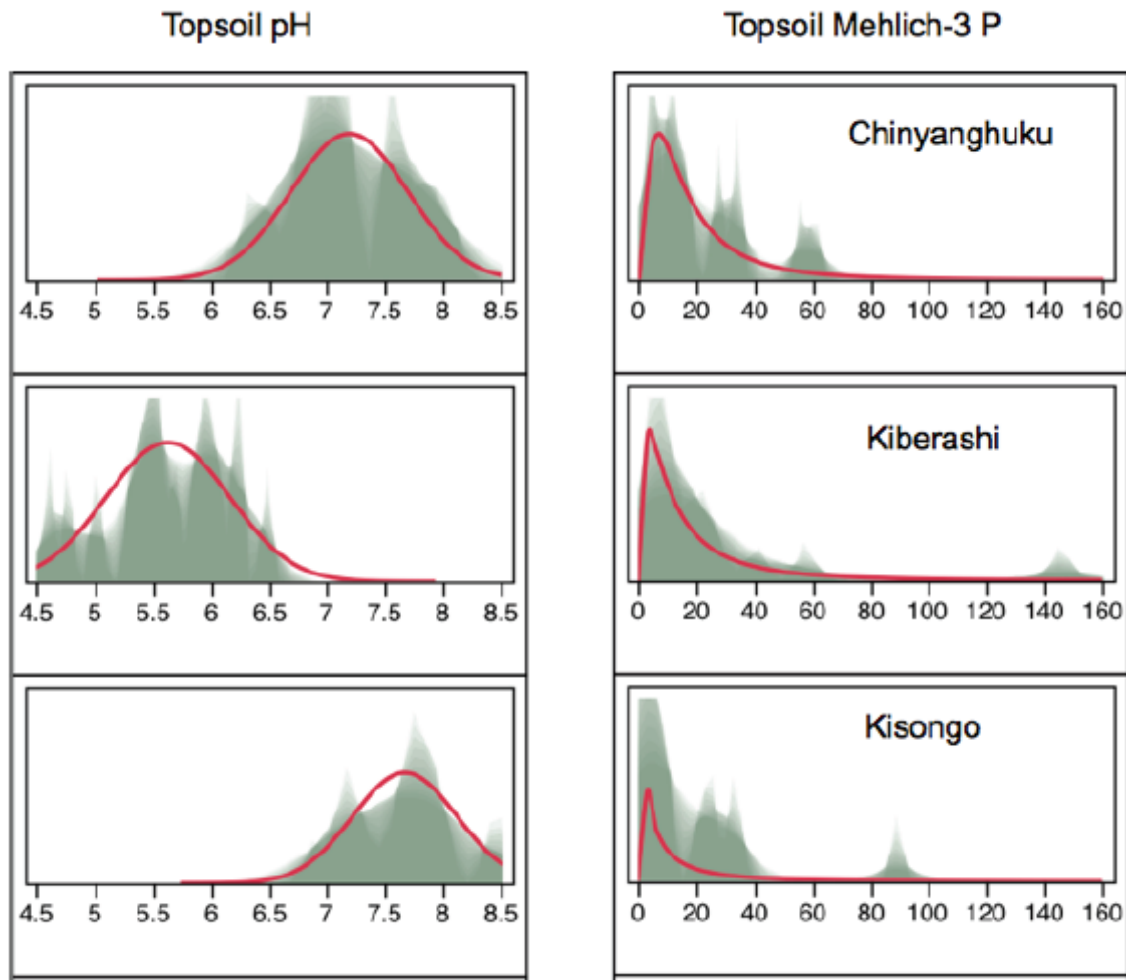
As well as the mixed agricultural systems such as in the Matufa LDSF site, Cluster 3.

Key measurements and analysis

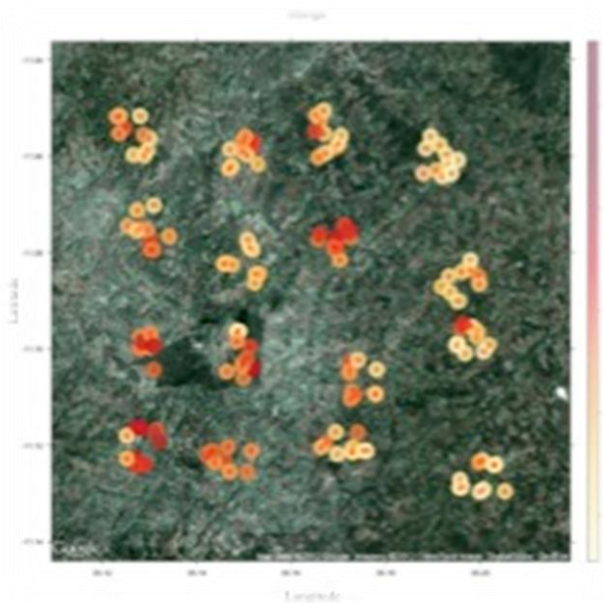
- Soil texture
- Soil chemical properties
- Soil mineralogy
- Plant cover
- Erosion prevalence
- Slope/elevation
- Cumulative mass
- Infiltration rates...



Soil property distributions



From Field Sampling to Predictive Maps

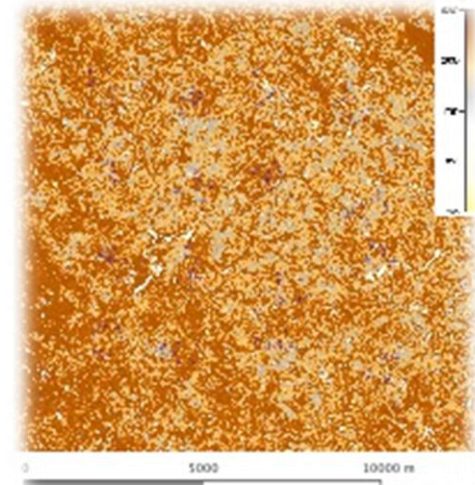


1) Conduct field surveys



2) Use mixed effect models to understand variability

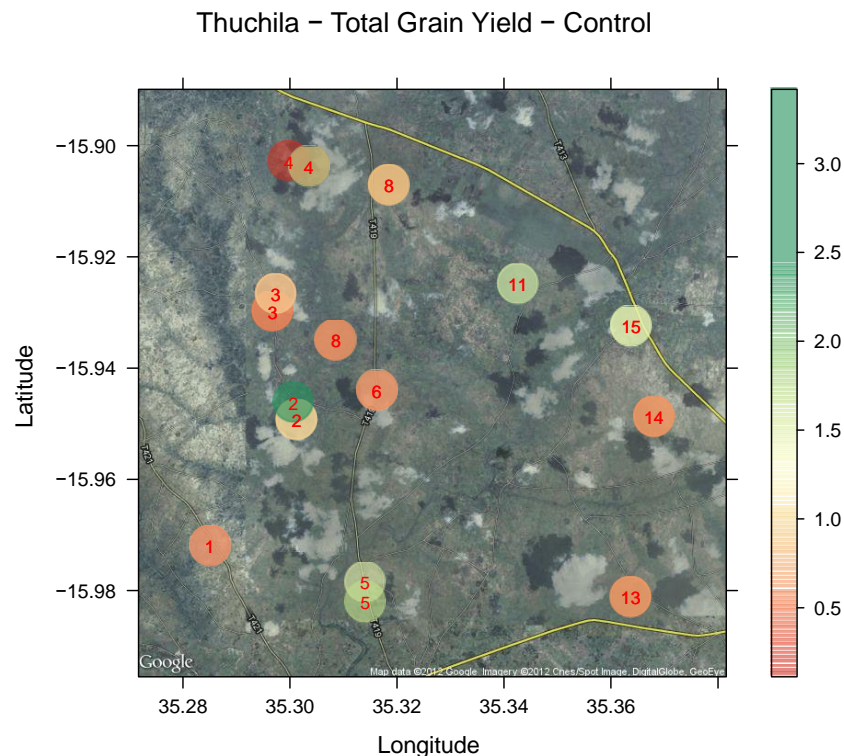
3) Create predictive maps



<http://www.rpubs.com/tor/soilmappingR-1>

Production survey: why

- Obtain actual yields under farmer conditions
- Assess and understand reasons for yield gaps
 - Management practices
 - Land conditions e.t.c
- Identify promising farmer innovations
 - “Farmers have tried options and have ideas of what works best”
- Derive appropriate interventions



Production survey: how

- Measure and mark out farmer plots
- Obtain field history
 - Organic resource management and chemical fertilizer use
 - Rest periods...
- Obtain current crop management (season of assessment)
- Obtain actual yields from marked-out plots
- [?] Plots are selected from randomized plots where soil sampling is done.



Production survey: what

- Soil quality and grain quality relations
- Land condition influence on crop yield



Field condition



Management



Crop yield



Quality [?]



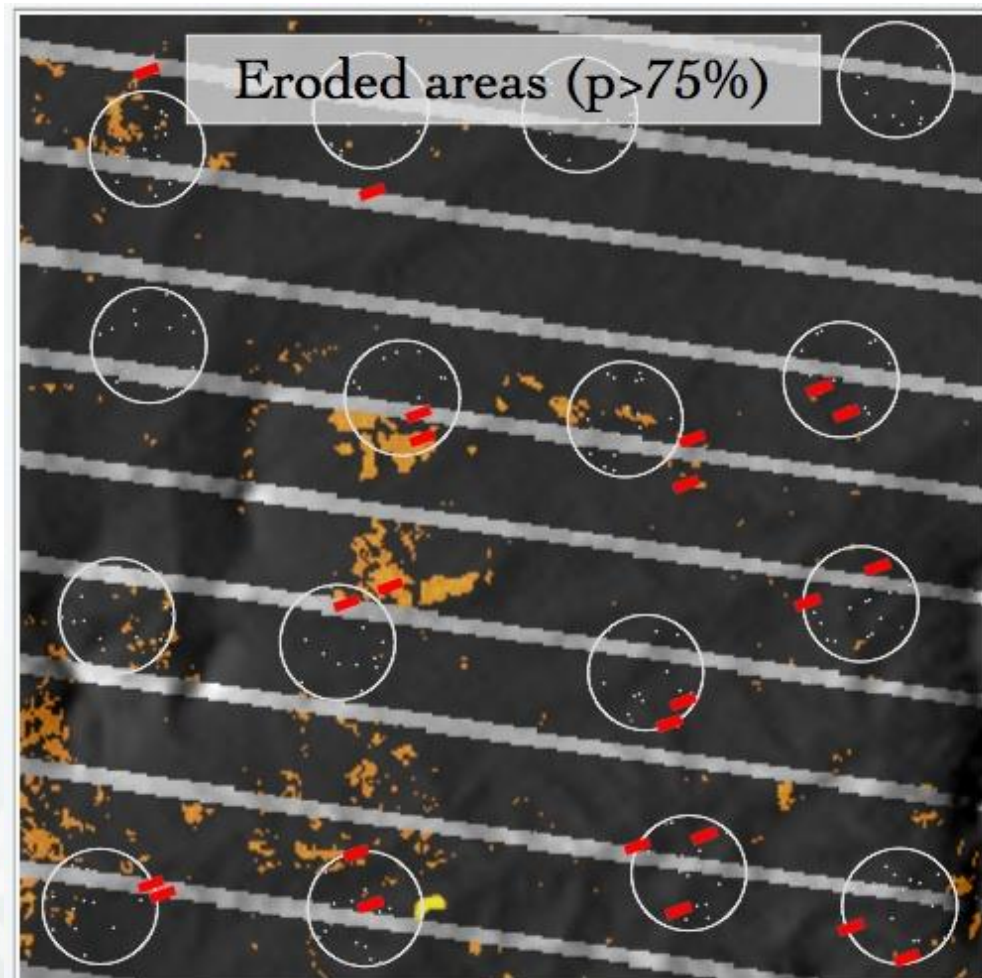
Linking Soil Health and Agronomic Data

To better understand variation in yield across the landscape:

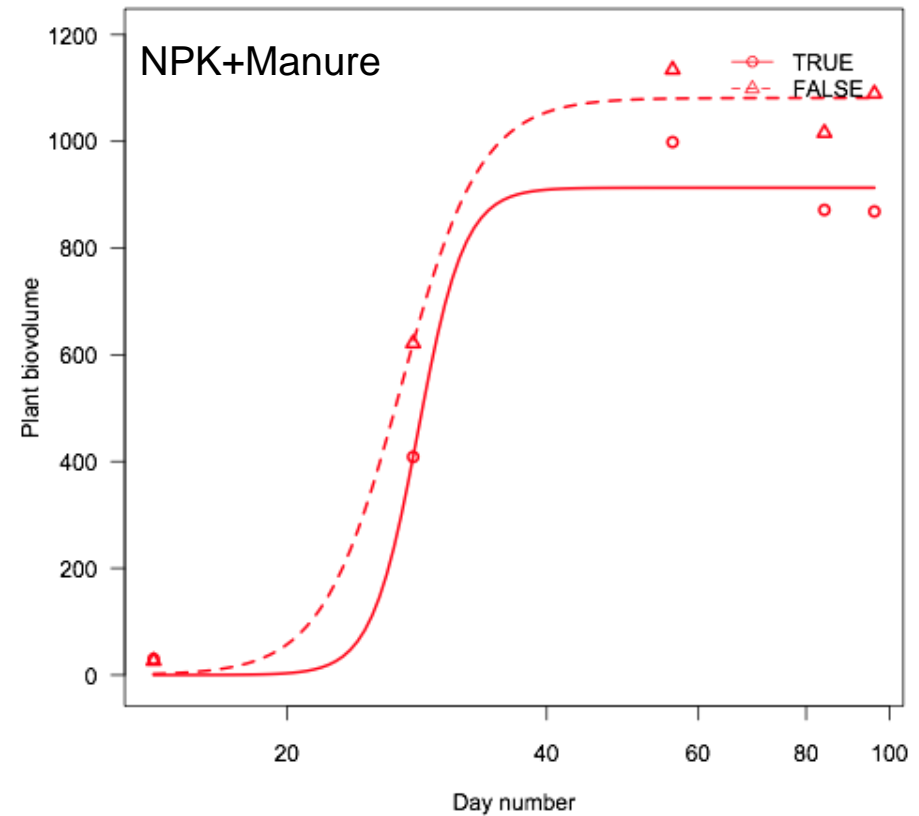
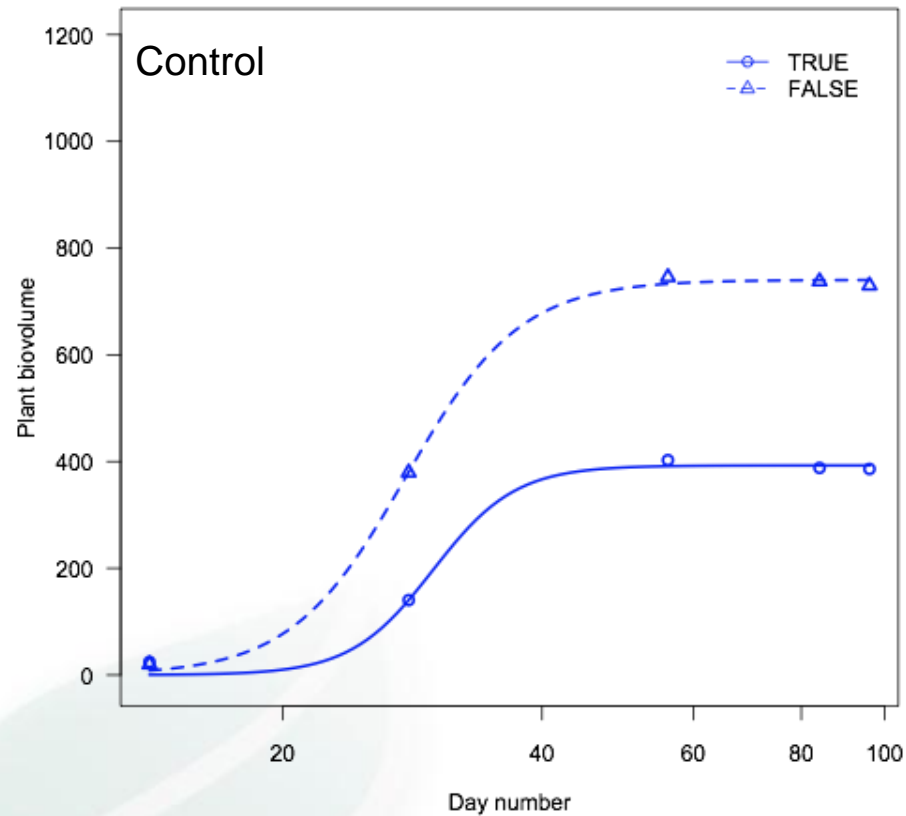
1. Identify baseline soil condition
 - soil pH, soil organic carbon, base cations, N,P,K
 2. Assess land health condition
 - erosion prevalence, root depth restriction, trees on farm
 3. Identify agronomic practices and local yields
 - land management practices (spacing, fertilization, tillage, etc.)
- 2) Combine these dataset to identify land health constraints to agricultural productivity



Linking agronomic data with soil survey



Kiberashi -Erosion risk areas



Crop growth response in eroded (TRUE) vs non-eroded (FALSE) areas

Diagnosis of nutrient deficiencies

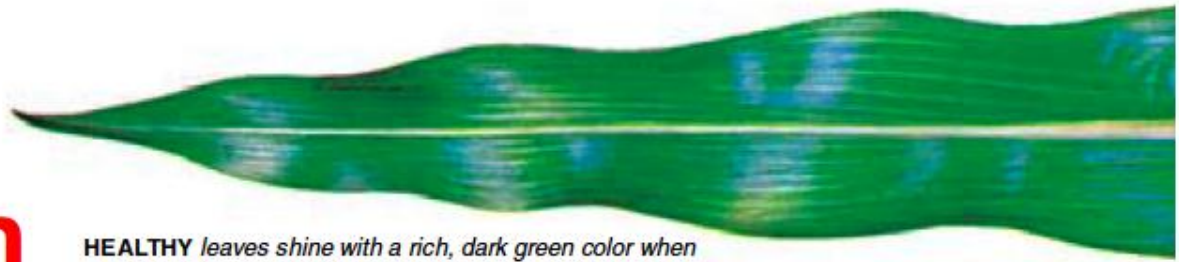
- Increase farmer knowledge of diagnosis
- Each farmer can diagnose their crop
- Simple illustrations/visual aids available
- Create/initiate interactions between farmers and scientists (extension and researchers)
- “Be your own maize doctor”

Be Your Own Maize Doctor

HAVE YOU had a “maize check-up” this season? Every grower should learn to recognize the symptoms that are pictured here — signs that a maize crop is deficient in one or more of the nutrients that are essential for healthy plant growth and profitable yields. You can be your own maize doctor. It is an important part of crop management to look at fields regularly and identify signs that problems are developing.

Nutrient Deficiency Symptoms

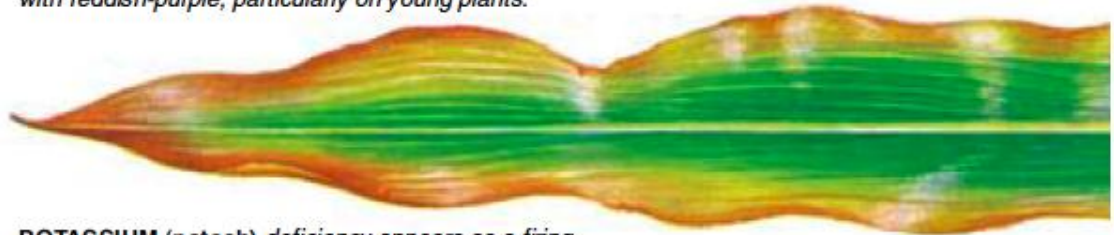
Optimum economic returns on your crop production investment depend upon an adequate nutrient supply throughout the growing season. These nutrient deficiency symptoms indicate that this need is not being met. Check the field several times during the season. Some deficiencies detected early may be cor-



HEALTHY leaves shine with a rich, dark green color when adequately fed.



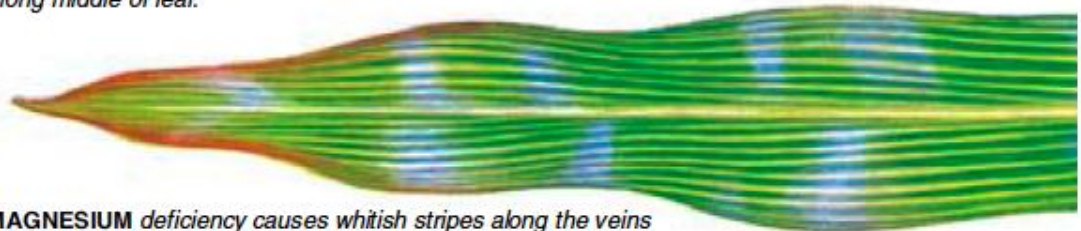
PHOSPHORUS (phosphate) shortage marks leaves with reddish-purple, particularly on young plants.



POTASSIUM (potash) deficiency appears as a firing or drying along the tips and edges of lowest leaves.



NITROGEN hunger sign is yellowing that starts at tip and moves along middle of leaf.



MAGNESIUM deficiency causes whitish stripes along the veins and often a purplish color on the underside of the lower leaves.

Training

- Translate “maize doctor” into Kiswahili for use in region
- Re-train/refresh extension personnel
- Train farmers within organized (sub)village meetings
- Distribute copies to sub-village offices
- Extension staff reach out to more farmers
- “Educated community of farmers”

[illegible]

doctor
Train farmers on use of r
Data analysis and report

Thank you

